DETERMINATION OF AGE BY RADIOLOGICAL EXAMINATION OF SHOULDER JOINT

Dissertation submitted in partial
fulfillment of the requirements for the degree
M.D.(Forensic Medicine) BRANCH - XIV

INSTITUTE OF FORENSIC MEDICINE
MADRAS MEDICAL COLLEGE
CHENNAI–600003

THE TAMILNADU
Dr. M.G.R. MEDICAL UNIVERSITY
CHENNAI

APRIL2016

BONAFIDE CERTIFICATE

This is to certify that the work embodied in this dissertation entitled **"DETERMINATION OF AGE BY RADIOLOGICAL EXAMINATION OF SHOULDER JOINT"** has been carried out by **Dr. D.S.SARAVANAN** a Post Graduate student under my supervision and guidance for his study leading to Branch-XIV M.D. Degree in Forensic Medicine during the period of November 2014to September 2015.

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DECLARATION

I **Dr. D.S.SARAVANAN** solemnly declare that this dissertation titled **"DETERMINATION OF AGE BY RADIOLOGICAL EXAMINATION OF SHOULDER JOINT"** is the bonafide workdoneby me under the expert guidance and supervision of **Prof. Dr. R.Vallinayagam**, Director and Professor, Institute of Forensic Medicine, Madras Medical College, Chennai – 3. This dissertation is submitted to The TamilNaduDr.M.G.R Medical University towards partial fulfillment of requirement for the award of M.D. Degree (Branch - XIV) in Forensic Medicine.

Place: **Dr.D.S.SARAVANAN**

Date:

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25 NOV 2014

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CERTIFICATE OF APPROVAL

To
Dr. D.S.Saravanan
Postgraduate M.D.(Forensic Medicine)
Madras Medical College
Chennai – 600 003.

Dear Dr. D.S.Saravanan,

The Institutional Ethics Committee has considered your request and approved your study titled **"Determination of age by radiological examination of shoulder joint". No.18112014.**

The following members of Ethics Committee were present in the meeting held on 11.11.2014 conducted at Madras Medical College, Chennai-3.

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We approve the proposal to be conducted in its presented form.

The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

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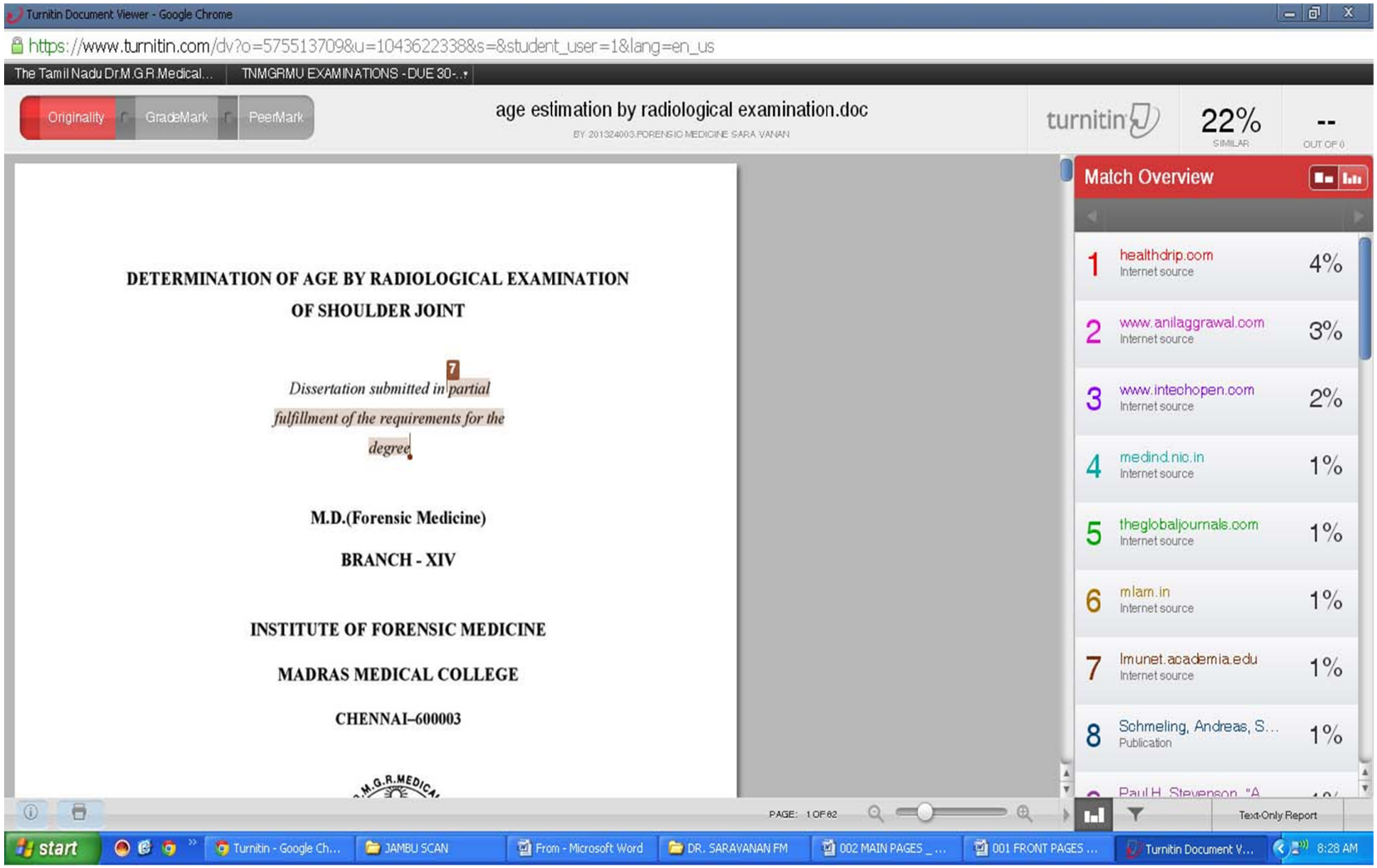
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ABSTRACT FOR THE DISSERTATION TO BE SUBMITTED TO THE TAMILNADU Dr M.G.R MEDICAL UNIVERSITY, CHENNAI FOR APRIL2016 M.D.FORENSIC MEDICINE EXAMINATIONS

TITLE: DETERMINATION OF AGE BY RADIOLOGICAL EXAMINATION OF SHOULDER JOINT

Abstract:

Age estimation of an individual is of medicolegal importance. Age becomes an important criteria for voting, driving licence, marriage, in civil cases e.g. to get government jobs and pensions. In criminal cases, the judgment is based on the opinion about age given by the forensic experts.

Ossification centres appear in a fairly definite sequence at a particular age group and fuses at a particular age group from which an age of the individual can be determined.

Materials and methods:

60 subjects were randomly selected from various schools, from neighbourhood as well as the cases attending the OPD of General Medicine Department of Madras Medical College, Chennai – 3.

Conclusion :

None of the cases in the age group of 16 – 17 yrs among males showed fusion of the secondary ossification centre of the shoulder joint.

30.76% and 28.57% of the cases showed fusion of the secondary ossification centre of the shoulder joint among males in the age group of 17 – 18yrs and 18 – 19 yrs respectively.

30%, 40%, 50% of the cases showed fusion of the secondary ossification centre of the shoulder joint among females in the age group of 16 – 17 yrs, 17 – 18 yrs, 18 – 19 yrs respectively.

In the present study, it is observed that the mean age at which the secondary ossification centre of the shoulder joint fuses is 18 – 19 yrs in both boys and girls.

In the present study, the fusion of the secondary ossification centre of the shoulder joint occurred one year later among females in comparison to ages mentioned in various standard literatures.It is due to the racial, economic, hereditary and hormonal factors.

Keywords:

Age estimation, Secondary centre, Shoulder joint, Radiographs.

1. INTRODUCTION

Identification means determination of individuality of a person. Identification is very important to be determined both in living and the dead person. Fixing up of the individuality of a person has got its own significance in civil cases like inheritance of property, passport, missing persons, disputed sex, marriage or in criminal cases like identification of a accused in criminal offences of murder, dacoity, sexual offences etc.

Identification may be of two types : complete and partial. Complete identification refers to the perfect fixation of the individuality of the person and also called as absolute identification. Partial identification or incomplete identification implies ascertainment of only some traits or facts about the identity while the others remain unknown.

For establishment of the corpus delicti after homicide, accurate identification is necessary since portions of a dead body or bones or unclaimed bodies are sometimes brought forward to support a false

charge. The term corpus delicti is the establishment of identification of the dead body.

Age, Sex and Stature constitutes the three primary characteristics of identification. Identification of the individuals would be difficult based on visually who died in mass disasters, air crash accidents, explosions, fires, advanced decomposition, earthquakes, exhumation and terrorist act.

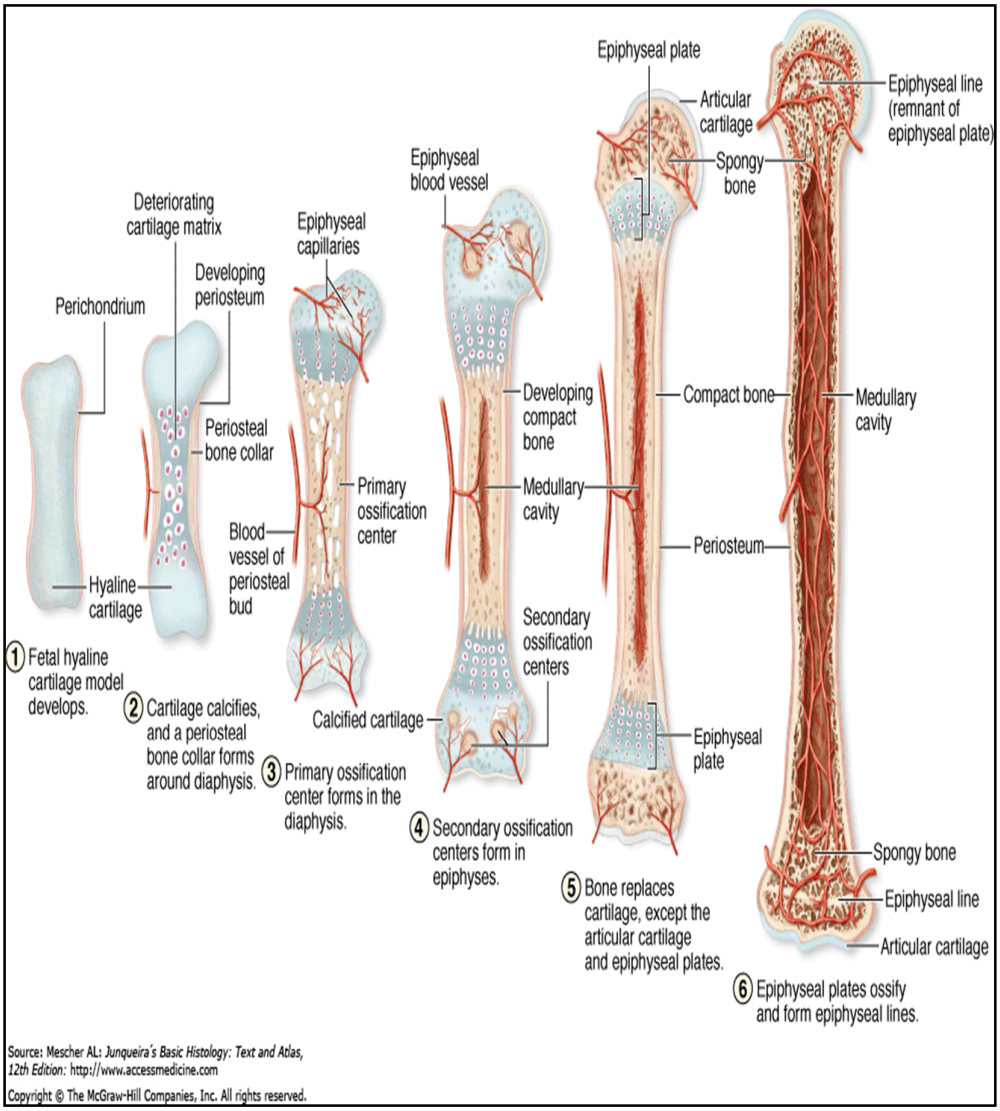
As a matter of fact, no age is exempted from a medicolegal point of view. From the moment of conception to the death of an individual, almost every age has some medicolegal importance. Particularly, the age of the individual is of paramount importance in employment and retirement both in private and government sectors. So the assessment of age with a degree of objectivity and certainity is important in medicolegal circumstances.

During a person’s life span, their bones would constantly undergo changes and those changes that occur in the skeleton would follow a chronological pattern. Knowledge on those changes occurring in the bones would help in estimating age from the skeleton. The timing of appearance of the ossification centres and the

process of fusion of the epiphysis with the diaphysis have a sequence and time period, which is utilized for age determination.

However, countable differences may be noticed in the time sequence of appearance and union of the ossification centres depending upon race, sex and geological distribution. Ossification process may also be influenced by food, nutritional status and physical activity, hormonal and metabolic disturbances. Ossification activities occur earlier in Indian population than in western population.

Different anthropological observations have been noted in populations belonging to various geographical regions due to several factors. Generally, the formula used for estimating age, sex or stature of one population cannot be evenly applied to all other population. Hence, specific data of particular population are required to be analysed and formula for each population is to be derived. Due to various changes that occur in the population parameters over time, the formula so derived need to be analysed periodically to observe for any modification.



The bone of human skeleton develop from separate ossification centres. From these centres, ossification progresses till the bone is completely formed. Radiological examination of the bones helps in analyzing these changes. Therefore, it is possible to estimate the approximate age of an individual by radiological examination of the bones till ossification process is complete.

Skeletal age of an individual can be determined based on the characteristic changes that occur during epiphyseal union. This skeletal age which when compared with age -based standards provides an estimation of chronological age of an individual. In forensic age diagnosis of living adolescents and young adults, radiological assessment of the degree of ossification of the medial clavicular epiphysis plays a vital role.

Based on the various studies it was analysed that commencement of union of the ossification centres can be detected significantly earlier with the radiographs and computed tomography when compared with dry bone observations.

2. AIMS AND OBJECTIVES

1. To estimate the age of an individual from the fusion of the secondary ossification centre of the shoulder joint.

2. Study of average age of fusion of the secondary ossification centre of the shoulder joint.

3. Comparative study of fusion of ossification centres on shoulder joint in boys and girls.

3. REVIEW OF LITERATURE

Identification is essential in living person, recently dead persons, decomposed bodies, mutilated and burnt bodies and skeleton. Age of a person is essential factor in establishing the personal identity. The age determination of an individual is based on the assessment of the physiological age of the skeleton, as opposed to the chronological age.

The physiological age of an individual is based upon relative growth patterns and it gives an accurate estimation of the chronological age, but factors like nutrition, environment and disease stresses cause changes in the skeleton which will mask the true age of a person. The accuracy of age determination varies inversely with the age of the individual at death. More precise age estimates are possible in younger years because age will be determined on the developmental changes, whereas in older age groups, observation of degenerative changes offers less accuracy in age estimation.

The assessment of age should be based on numerous indicators. A Study group on Forensic Age Diagnostics, recommend that all

forensic age estimation should be based on combined evidence from physical examination, radiological examination of left hand, dental examination and orthopantomogram. Further, the study group analysed that to know whether the individual has reached the age of 16 years, conventional radiography or computed tomography of the shoulder joint.

The following are the age related changes and analysis of all these changes will help in estimation of approximate age of the individual.

I. General development, in case of children
II. Secondary sexual characters
III. Dental eruption and Occlusion
IV. Cortical Bone Histology
V. Cranial Suture Closures
VI. Ossification of bones
VII. Pubic Symphysial Face Morphology
VIII. Age-Related Degenerative Conditions
IX. Phase Changes in the Sternal Rib

3.1 General development

The age of the foetus during intrauterine life can be assessed by studying the developmental morphology, appearance of ossification centres in the skeletal bones and also germination of teeth and by using Rule of Haase.

In childhood, age determination may be made from anthropometric measurements, closure of anterior and posterior fontanelle, appearance and fusion of ossification centres and eruption of teeth.

3.2 Secondary sexual characters:

Secondary sexual characters develop at the pubertal age. In an individual, sexual maturation usually follows a pattern and was classified in two stages by Tanner, commonly called as Tanner Grading. In male, at about 12- 13 years, sparse, long, lightly pigmented hair begins to appear at the base of the penis. At about 15 years, pubic hair resembles the adult type, the testes and scrotum become larger and firmer and the penis reached the adult size.

Between sixteen to eighteen years hair begins to appear on the face and the voice becomes hoarse.

It is observed that in boys pubic, axillary and facial hair grow at age of 14, 15,16 years respectively in majority of cases in their age groups respectively. The voice of the majority of the cases in boys were found to be man like or low pitched in boys from age 16 – 17 years onwards and the adams apple becomes prominent at age of 16 years onwards.

Development of the breast bud is the first sign of puberty in girls. Breast bud develops at about 10- 11 years of age. Fine, pale, downy hairs appear on mons pubis at 12- 13 years. There is gradual enlargement of labia majora, labia minora and clitoris. Axillary hair begins to appear few months before the onset of feminine type of body contour. The order of developmental changes would be breast development followed by the development of pubic hairs then the menarche results.

3.3 Dental Eruption and Occlusion:

Smith(1991) and Scheuer and Black (2000) used dental eruption methods for age determination. Eruption of the deciduous and permanent teeth and calcification of their roots are used for estimation of age of an individual. Ubelaker's illustrations about eruptive phases of the teeth are pointing out the standard deviations. Occlusal wear is also one of the indicators of age.

In a child, estimation of age from the dentition gives better results than the skeleton. For age estimation, from birth to fourteen years, the formation of root and crown structures, stage of eruption and mixed dentition are taken in to account. After fourteen years, the stage of development of third molar is studied for age estimation.

Third molar usually erupts between 17 -25 years of age, but it is highly variable. The third molar may be impacted in which case orthopantomogram of the jaw will be helpful to assess the developmental status of unerupted tooth and the degree of calcification of the tooth.

Physiological age changes that occur in each of the dental tissues are used for estimating age of adult over 21 years. Gustafson's method is used for age estimation by analyzing the secondary changes of teeth like Attrition, Paradentosis, Secondary dentin, Cementum apposition, Root resorption and Transparency of root. Boyde suggested a method to estimate the age of a child based on cross –striations that develop in the enamel of teeth. These cross striations are known as incremental lines. Neonatal line represents the major incremental lines that develops after birth. The subsequent lines that develop after the neonatal line are calculated and the age is deduced. By this method, age can be calculated in terms of days and is useful to determine the age of an dead infant.

Study of the morphological parameters of teeth on X rays for estimation of age also has a higher reliability. The Dimensions of teeth do not change significantly during growth. Thus they can be easily used for estimation of age. The advantages of radiography adds further value to this method.

Several methods has been introduced in to the age estimation using dental radiographs like apex closure and tooth formation. This ratio indirectly determines the deposition of secondary dentin.

Secondary dentin is not influenced by the environmental factors. Therefore this method is very accurate.

Secondary dentin deposition has a close association with the chronological age and can be indirectly measured using radiography. Paewinsky has concluded that the mesiodistal width of the maxillary. lateral incisors showed a significant association with the patient's age. Canine tooth is the most suitable due to its large pulp chamber, less wear and chance of staying longer for this purpose.

According to Bric et al., the teeths of both jaws are reliable for age estimation.

Fig.1 : HISTOLOGY OF CORTICAL BONE

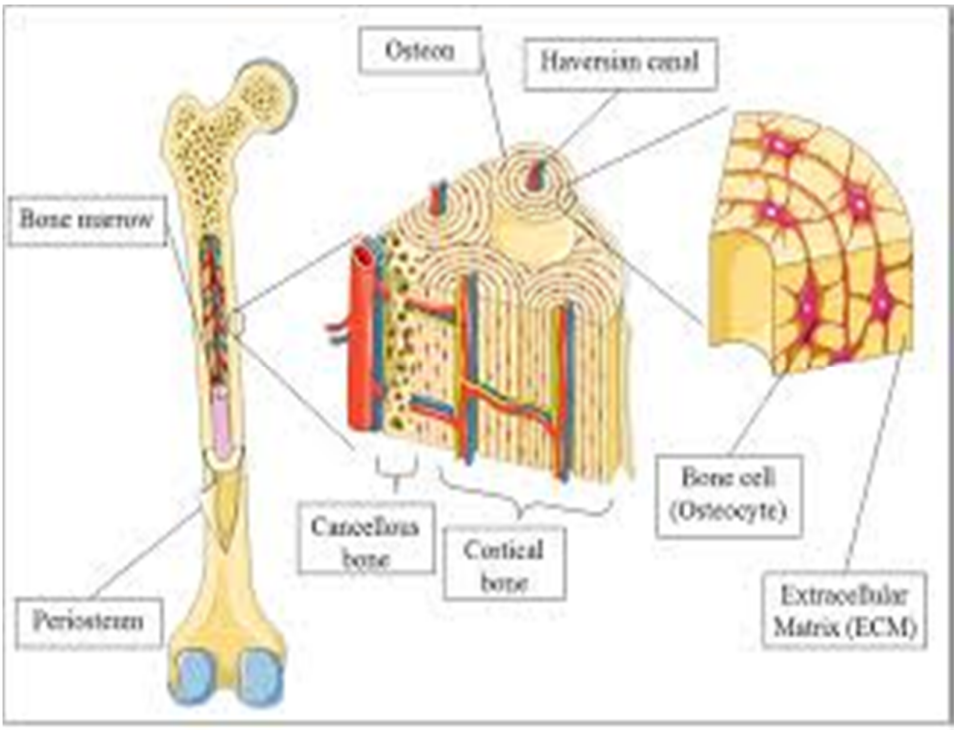


Fig.2 : MORPHOLOGY OF CORTICAL BONE

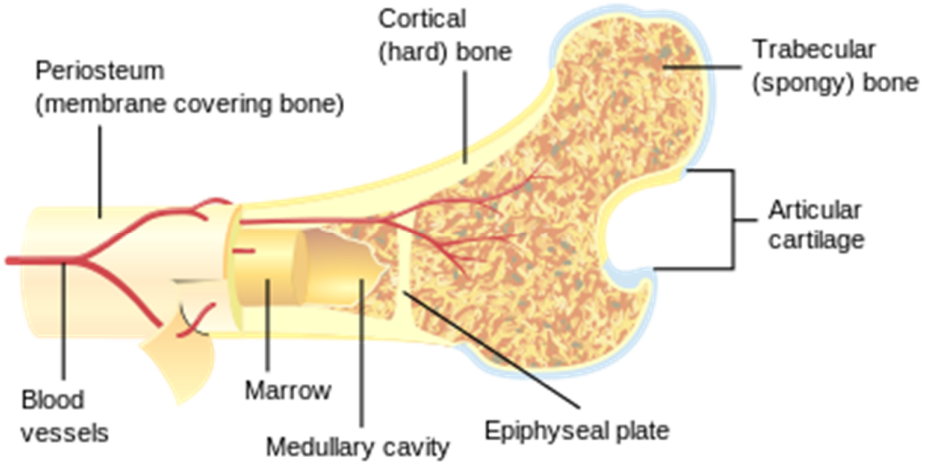
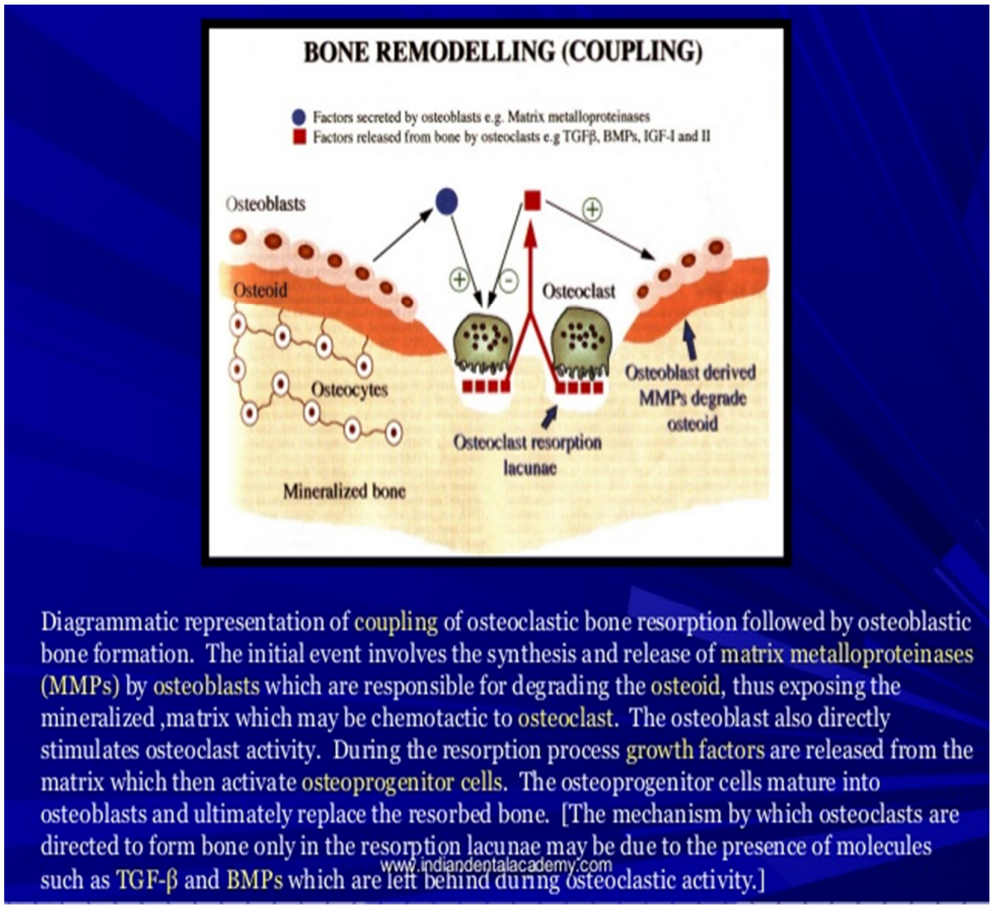


Fig. 3 : BONE REMODELING



3.4. Cortical Bone Histology:

Based on the histological observations, the first age estimating equation, in bone sample was derived by Balthazard and Lebron (1911). However, Kerley (1965) was the first one, who published the technique of prediction of human skeletal age. He used histology of

bone for age estimation, based on counting the number of osseons in bone bits taken from midshaft region of long bone sections.

A percentage assessment was estimated. Pre determined age profile chart or regression formula was deduced based on these percentages. Kerley concluded that, a reliability of almost 90% with +/- five years can be made out with a good correlation from the fibula, then the femur and the tibia. He analysed variables like number of osteons, number of osteon fragments and percentage of lamellar bone the percentage of circumferential lamellae of cortex of bone.

Rai et al had derived a regression equation for estimation of age. The equation is Age = number of osteons + 8.3.

This method is useful in sub adult and adult population.

Automated measurement through entire cut section of femoral diaphysis would enable the estimation of age other histological methods used for age estimation in adults and histomorphometry of femur (Watnabe yet al) osteon remodeling (Ortner DJ) and double lamellae in trabecular osteons in ilium. (Boel LW et al 2007).

3.5. Cranial suture closures

The fusion of the sutures of the skull bones is analogous with the epiphysis-diaphysis union. The suture closure first begins endocranially and then ectocranially. The degree of cranial suture closure usually follows a stipulated time which is used for age estimation. Age will be calculated in the range of decade. Krogman had stated that vault sutures fuses between 17-50 years and circummeatal suture fused above 50 years. Ectocranial suture closure is very variable. Estimating age of the skull from suture closure is not a reliable method.

3.6. Ossification of bones

Epiphyseal union has been defined in to 5 grades by Mckern & stewart as follows a) No union b) beginning union c) active union d) recent union with scar and e) complete union with no scar.

These observations give a possible accuracy in the determination of age. Age estimation based on ossification centres were first used by the francis et al (1935) Noback (1954) Scheuer & Black (2000) & Scheuer (2002).

3.7. Pubic symphyseal face morphology

From third to fifth decades, pubic symphysis is probably the single best criteria for determining the age. Transverse ridges appear across the symphyseal surface by the second decade of life. From second decade of life this surface undergoes continous progressive metamorphosis. With this character, suchey & brooks have studied age estimation with the male pubic symphysis. Age from changes at the pubic symphyseal surface is considered more dependable than the cranial suture closure.

3.8. Age related degenerative conditions.

In an individual lipping of the margins of the vertebral bodies starts by 35 – 40 years. Senile osteoporosis is rarefaction of the bones that occurs after 60 years of age. Vertebral conditions was also studied for assessment of age by Albert & maples (1995) & Scheuer & Black (2000)

3.9. Phase changes in the sternal ribs

Iscan & Loth had established a method of age determination based on observable changes that occur at the sternal end of the fourth rib. These changes are parallel to those that occur on the pubic symphyseal surface. They are of exact morphological nature and occur at the costo-chondral junction between rib and sternum.

With respect to physiological age females are generally more advanced than males, being advanced about 2 years at puberty, 5 - 6 years at maturity and 7 - 10 years in the older age.

4. FACTORS AFFECTING THE APPEARANCE AND FUSION OF OSSIFICATION CENTRES

The process of appearance of epiphysis and their union with diaphysis has a sequence and occurs in chronological band a time bound that makes iota a reliable age indicator. However variations of sex, race, environment, nutrition and hormonal factors influence the appearance and fusion of ossification centres.

4.1 SEX

Union of epiphysis with diaphysis occurs earlier (1 – 2 years) in females than males. Probably due to estrogens which ultimately terminate growth by causing epiphysis to fuse with the shaft of long bones

4.2 RACE

In Americans and Europeans the ossification centres appear and unites 2 – 3 years late when compared to Indian population. However, Krogman stated that the difference in appearance and union is not due to the race, but it is due to the race, but is due to the genetic and deistic factors and environment has got its roles.

In India, south Indians show one to two years earlier appearance and fusion of the ossification centres. Modi (1957) stated that, it is not possible to formulate a uniform standard for age determination based on union of epiphysis as they are subjected to variations in climatic, hereditary, dietic and other factors. Based on various studies, it was observed that in Indians union of epiphysis occur 2 – 3 years earlier than Europeans and females showed onset of fusion than males.

4.3 NUTRITION AND THEIR DEFICIENCIES

Calcium, Vitamin D, Vitamin C and Iron are most important for growth and bone development. The deficiencies of these nutritional values affect the bone's integrity and strength. The deficiencies of these nutritional values affect the bone's integrity and strength. Deficiency of Vitamin D produces rickets in paediatric age group and osteomalacia in adults. In rickets there will be poor mineralization of the newly formed bone. In children, calcium deficiency also causes rickets.

Deficiency of Vitamin C leads to scurvy which is characterised by weakened connective tissues, reduced osteoid content and haemorrhagic disorders.

Histological study by Stout and Paine (1992) stated that nutrition and its deficiency played a definite role in assessing the age. The study showed that, when histological metthods are applied, the age was under estimated to those individuals who were affected by the nutritional deficiency diseases. Cordoso (2008) stated that nutritional deficiencies affect the skeletal maturation more during early childhood than during adolescence.

4.4 HORMONES

The skeletal growth and maturation is highly influenced by the secretions of the endocrine glands. Valuable information regarding the pituitary, thyroid and gonodal disturbances can be made out by the radiological examination of the growing skeleton. The disturbance in the secretions of these hormones results in generalised skeletal abnormality.

Deficiency of one or more of these hormones may delay the onset of appearance or union of the epiphyseal centres. Excess production of the growth stimulating hormones may accelerate the ossification process. Graham CB made an extensive analysis on the influence of hormonal disturbances on the skeletal maturation.

Due to the local increase in blood supply in rheumatoid arthritis, Tuberculous arthritis or healing fractures adjacent to a joint there may be focal increase in maturation. Infection, frostbites, burns and radiation therapy are other factors that contribute to focal disturbance in maturation.

Tanner at al., in their study observed earlier onset of skeletal maturation among the population among the same population over a period of time. He tabulated bone age values for North American children in 1990 and compared with the study conducted in the same population in 1960mand obsered a secular trend in growth and development over some decades.

5. UNCERTAINITY IN AGE ESTIMATION:

The aim of age estimation is to define in the most accurate manner the chronological of an individual for whom the age is unknown. However, the term ‘estimation’ means the actual limits that are inherent to this expertise. It has been analysed that exact chronological age of a person cannot be assessed by any medical test of now.

The uncertainity in age estimation are related to:

5.1 Individual biological variations:

There usually exists a large variation in the development between individuals of the same chronological age.

5.2 Reference datasets:

The human body exhibits a large natural variation and so reference standards may not express the full extent of variability in aging. The reference materials may also be unevenly distributed across all age classes. Reference datasets often quote with the estimates of standard deviation, but they will refer to the reference dataset and not to a population.

Reference datasets are usually population dependent and reference data are not available for all populations.

5.3 Inter and Intra – observer variations

5.4 Methodological errors and uncertainties.

Epiphyseal cartilage can be divided in to seven zones (Fig 3) :

i. Resting zone
ii. Zone of Proliferation
iii. Hypertophic Zone
iv. Zone of Calcificattion
v. Zone of retrogression
vi. Ossification zone
vii. Resorption Zone

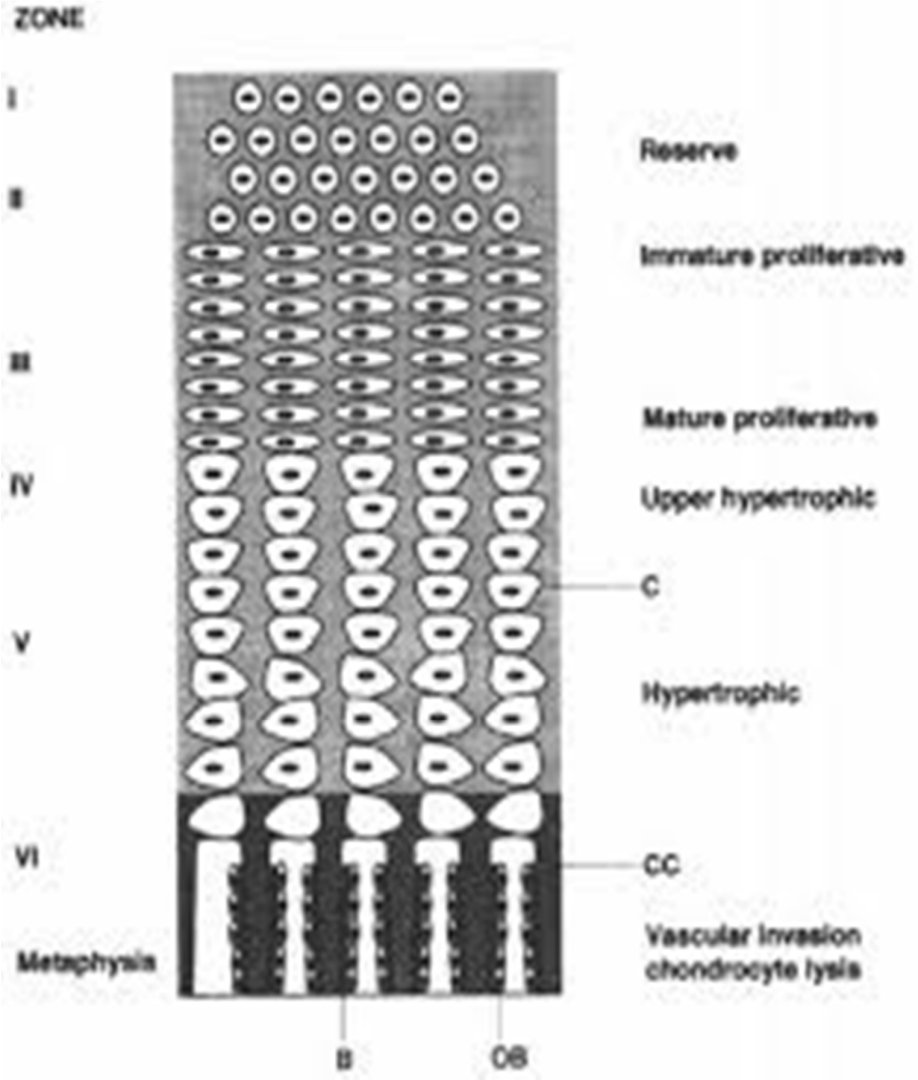


Fig. 4 : ZONES OF EPIPHYSEAL CARTILAGE IN HISTOLOGY

Resting zone also known as quiescent zone composed of mainly hyaline cartilage. It is situated nearest to the end of the bone. As ossification approaches, this initial short zone progressively shortens and slows down the growth in all directions.

Zone of proliferation is an active zone and involves the cells of the resting zone and producing daughter cells. It aligns themselves in distinct columns parallel to the long axis of the bone. Each row of cells grows by the addition of more cells and so forth. This mechanism allows the cartilage to increase in length.

Hypertrophic zone involves maturation of the cells, in which large lacunae can be found with thin adjoining septae.

The next zone involves calcification of the matrix surrounding the enlarged lacunae.

Following calcification, there is a zone of ossification. In this zone, the osteoblasts differentiate from the mesenchymal cells and gather the exposed plates of calcified cartilage. At this stage, osteoblasts lay down the bone and endochondral bone tissue appears.

The last zone is the zone of resorption. Resorption of the bone occurs in the center of the diaphysis and results in increase in size of the marrow cavity.

With the exception of the intramembranous bones in the skull, the bones of the skeleton are of endochondral origin being first preformed in cartilage. The cartilage takes on the characteristic shape of the bone and is replaced by osseous tissue. A typical long bone has three centres or principle loci of growth: the shaft or diaphysis; and two end portions, proximal and distal epiphysis.

At either end, between diaphysis and epiphysis, is a plate of hyaline cartilage, which is the diaphyseo - epiphyseal zone or metaphysic. It is here that growth actually occurs until the epiphysis unites with the diaphysis.

As a general rule, the aging of bones is more precise with respect to appearance of ossification centres than with the fusion of the ossification centres[11]

The bones forming the human skeleton of the human body are performed in hyaline cartilage. This soft tissue is converted gradually in to hard osseous tissue by the development of the osteogenesis that occurs exactly in the central portion from which the transformation process proceeds until the ossification of the skeletal elements

completes. Centres of ossification appear over a long period of time, of which most of them appear during embryonic life, some appear in pre-natal life and others after birth.

At eleventh prenatal week, there are 806 centres of bone growth, at birth there are about 450 centres while the adult skeleton has only 206 bones. Nearly 600 bone growth centres disappear from 11th prenatal week to the final time of union. That is they coalesce with the adjacent growth centres to give the definite adult bones. This process of appearance and fusion of the ossification centres has a definite sequence over a period of time that makes it reliable indicator of age.

Study of the radiographs regarding the appearance and fusion of the secondary ossification centres will enable in assessing the approximate age of the individual.

Many bones are ossified from a single ossification centre, e.g. tarsal and carpal bones. Most bones are ossified from several separate foci, one of which appears near the middle of the future bone. This centre is concerned with progressive ossification towards the nds of

the bones. In all such bones their ends are cartilaginous at birth. These terminal regions are ossified by separate centres, sometimes multiple; they are said to b as secondary centres.

Krogman (1960) reviewed the reliability of the identification of the human skeletal remains. The skeleton formed by bones which are made up of hard durable minerals and as such thy resist decomposition for a longer period. Study of the bones gives information regarding the age, sex, injury sustained by the person and some pathological information including those arising from chronic poisoning with heavy metals. DNA typing of the individual can be arrived by serologic testing of the bones.

OSSIFICATION

All bones are mesodermal in origin. The process of bone formation is known as ossification. There are two types of ossification.

(A) INTRAMEMBRANOUS OSSIFICATION

(B) ENDOCHONDRAL OSSIFICATION

6. RADIOLOGICAL EXAMINATION OF SKELETAL CHANGES

Based on osteological study, Stevenson was the first, to study the epiphyseal union with known age, sex and race. The four stages recognized by Stevenson are:

- No union,
- Beginning union,
- Recent union and
- Complete union.

6.1 Stage of no union:

There will be clearly evident gap between the epiphysis and diaphysis with resemblance of saw - tooth along the external margins of the approximated epiphyseal and diaphyseal surfaces.

6.2 Stage of beginning union:

The superficial hiatus that was found between epiphysis and diaphysis is replaced by a line. Deposition of finely granular new bone in the depressions results in gradual replacement of the

characteristic saw tooth appearance of the approaching margins. The process of bridging over and progressive obliteration of the epiphyseal line starts from this stage.

6.3 Stage of recent union:

The stage of recent union is characterized by retention of fine line of demarcation, although the active process of bony fusion is over.

6.4 Stage of complete union:

In this stage the process of union gets completed.

To know whether a person has reached 18 years, it will be helpful to evaluate the ossification status of the medial clavicular epiphysis, since all other examined developmental systems may already have completed their ossification activities by that age.

A large number of studies have been conducted on the time frame for the ossification of the medial clavicular epiphysis in the age group concerned for forensic age diagnostics. Todd and D' Errico, McKern and Stewart, Shirley et al conducted studies by

assessing the ossification of medial clavicular epiphysis in autopsy or direct skeletal inspection. Some others conducted study based on the radiological approach such as conventional radiography, computed tomography (Fig 4) and new approach such as MR imaging and ultrasound.

It has been pointed out by several authors that the data obtained from dry bone material are not directly comparable with values from radiological studies. Krogman and Kreitner et al., argued that commencement of union can be observed in radiographs before any union of epiphysis can be made visible on dry bone. Therefore reference values from studies on dry bone should not be applied to assessments based on radiographical examination[28]

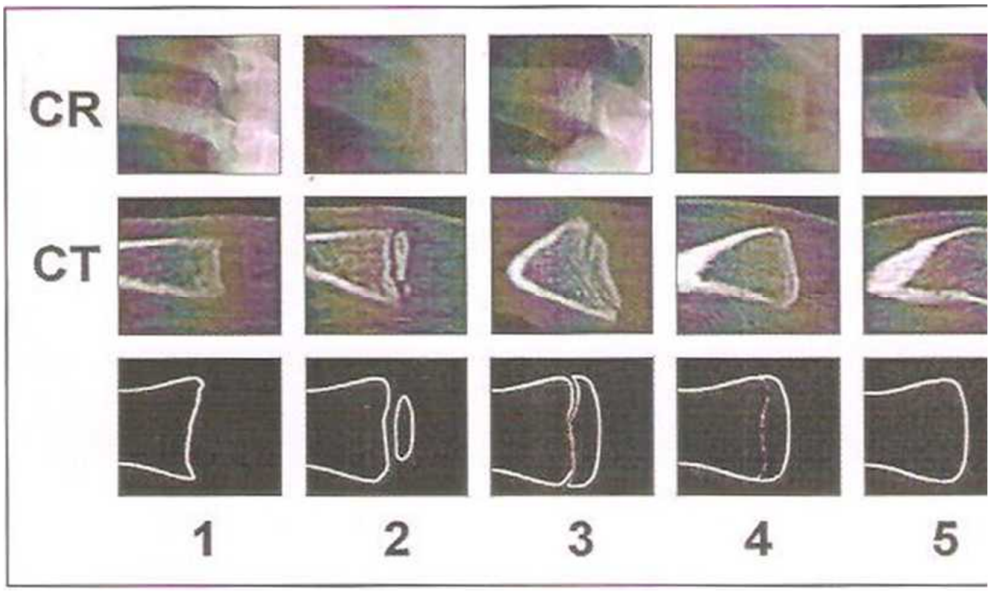


Fig. 5 : Schematic pictures of the stages of medial clavicular ossification (stage 1 - 5) in conventional radiography (CR) and computed tomography (CT)

Stage 1	:	Secondary ossification centre has not yet appeared
Stage 2	:	Secondary ossification centre has just appeared
Stage 3	:	Secondary ossification centre appeared and Started fusion with the shaft
Stage 4	:	Secondary'- ossification centre partly fused
Stage 5	:	Complete fusion.

Computed tomography can be used o analyse the stage of epiphyseal fusion, but most of the studies use slice thickness that are too thick so that meaningful details about the various stages of fusion cannot be detected.

Kreitner [29] et al (1998) in their study used the slice thickness with the range from 1mm - 8 mm. The epiphyseal union is classified into four stages:

1) Non union without ossification of epiphysis, 2) non-union with detectable ossification of epiphysis, 3) partial union, 4) complete union of the epiphysis with the clavicular shaft.

The ossified epiphysis appeared between 11 to 22 years. Partial union was observed between 16 - 26 years. Earliest age of complete union was observed in 22 years and union was complete in all the individuals by 27 years. Statistically no significant difference was noted in union between males and females.

However, caution must be laid in scoring CT scanned bones from scans of varying slice thickness because details appreciated in 1 mm thickness may not be visible at 8 mm thickness slice.

Apart from conventional radiography and computed tomography, Digital ultrasonic system[30] and Magnetic Resonance Imaging have been used to evaluate the stage of ossification of the medial clavicular epiphysis. Digital ultrasonic system and Magnetic Resonance imaging[31] have the advantage of less radiation exposure. Schulz et al in their study analyzed that the age intervals for the ossification stages were consistent with the known data from radiological and CT assessments. But the results should be confirmed in a larger proportion of cases and with analysis of interobserver variability.

FORENSIC RADIOLOGY IN IDENTIFICATION:

7. Forensic Radiology in identification:

Forensic Radiology is an area of expertise in medical imaging which utilises radiological techniques to aid physicians, pathologists and medico legal experts in matters associated to the law[31]. The importance of radiology in identification of body was realised by Gray when he examined mummies in the museums of Great Britain and other European countries. He found that radiological examination of the mummies was helpful in determination of sex and in the estimation of age[35].

Radiological examination of the pelvis, skull, frontal bones and mandible may give definitive information about sex of the individual[34]. It has been demonstrated that in 88 percent cases sex can be determined accurately from radiological study of the skull. Radiological study of costal cartilages calcification pattern is a recent advance in sex determination.

Age can be determined from a radiograph. Orthopantomogram

helps in determining age of an individual based on tooth eruption. It may also reveal tooth restoration particularly which can directly help establishing the identity with great accuracy. By measuring the diaphyseal length and demonstrating the ossification centres one can estimate the length and age of the foetus. Appearance of ossification centres and its fusion is a well established method of age determination approved by the court.

The ossification centres present in the wrist radiograph are useful in age determination in infants and children. In adolescent, demonstration of the epiphyseal union at the wrist and pelvis helps to evaluate the age. In the fifth decade of life, X ray can demonstrate calcification of laryngeal and costal cartilages.

Radiographic identification by studying frontal sinuses has been found very useful in mutilated bodies or burnt bodies[35]. In 1931, Poole stated that no two persons even the identical twins have the same profile of the frontal sinuses. They appear in second years of life and increase in size for the first two decades. For the sinuses to be used as identification feature, antemortem anteroposterior skull X

ray must be available. Superimposition technique of skull can also be employed to find the identity.

Other radiological methods for comparing identity include matching of wrist film, matching the profile and structure of first rib and the clavicle. In general, it is said that when antemortem X rays of the skull, thorax, or shoulder hip are available, then radiological comparisons of dead material can be done and this can almost exclude an identity and thus on several circumstances identity is confirmed.

The x ray or roentgen ray is an energy form of ionizing radiation from which may be produced fluorescent or photographic images. The photographic image is called as x rays or roentgenograms[36].

Discrepancies regarding radiological examination of epiphyseal union with their respective diaphysis:

In naked eye examination of a bone, the epiphyseal gap appear as a circular groove around the ends of a bone. On radiological examination of the same bone, the epiphyseal gap is seen as irregular line which resembles a fracture.

7.1 Epiphyseal scar:

In an x ray film of the growing ends of long bones, there will be a dense white line seen at the junction of epiphysis and diaphysis and it is called as epiphyseal scar. Once it was considered as an evidence of recent or incomplete fusion of epiphysis with the diaphysis. However, Krogman reveals that, the white line is due to maintenance of radiographic opacity at the site of the piled up calcification adjacent to epiphyseo diaphyseal plane, and it may persist for several years after demonstrable complete union in the bone itself.

Comparing the bone with radiological film:

The problem of evaluating and comparing the cpiphyeal union on the bone with the radiograph is a difficult one. Drennen and Kenn (1953) stated that the periods of fusion indicated by radiograph of

bony extremities are approximately three years earlier than the periods of fusion indicated by anatomical evidence, since the epiphyseal lines can remain visible on the bone for a considerable time after the radiograph indicate that fusion has taken place.

Krogman stated that the difference between the bone and radiological film with respect to epiphyseal union is not too great and probably not more than $\pm$ 6 months. Hence, he disagreed with the concept 'three years earlier' dictum in favour of x rays. He also denied that the persistent scar in the x ray film as an evidence of incomplete or recent union.

7.2 Radiation exposure during radiography:

For forensic age estimation, X ray examination are carried out without a medical therapeutic reason and the question arises whether there are any risks to the individual due to radiation exposure.

The effective dose from X ray examination of

Hand is	-	0.1 microsievert
Orthopantomogram	-	26 microsievert
Clavicle	-	220 microsievert

For CT scan of the clavicle the exposure is calculated as 600 microsievert[37]

The use of X ray and CT examination of the clavicle should be restricted to individuals with completed hand ossification because of the relatively high effective dose. It has been studied that the radiation exposure from an intercontinental flight at an altitude of 12,000 meters is 0.008 microsievert per hour. It shows that the radiation exposure from two orthopantomogram is equivalent to the radiation exposure from an intercontinental flight. On the basis of this comparison , a true health risk

As a result of X ray examination for forensic age estimation can be largely excluded (schemling et al.,)

Previous studies:

Todd and D'Errico[4] (1928) scored the epiphyseal union of medial end of the calavicle into to 4 phase system:

i. No Union
ii. Beginning union
iii. Recent union with a scar
iv. complete union with loss of all trace of the site of union
v. Non-union with no epiphysis
vi. Non union with separate epiphysis
vii. Partial union
viii. Complete union

7.3 The ossification process was divided into the following 4 stages

Stage1 : Ossification centre not appeared

Stage 2 : Ossification centre appeared but no union

Stage 3 : started but it is incomplete

Stage 4 : Complete Union.

Schaefer and Black scoring was used to grade the ossification of medial clavicular epiphysis.

- Score 0 – No fusion
- Score 1 – Less than one third of there epiphysis showing union or active fusion
- Score 2 – Approximately half of the epiphysis showing union or active fusion
- Score 3- More than ¾ the of the epiphysis showing union or recent fusion or recent fusion
- Score 4 – Complete union.

S.S. Bhise et al (2012) conducted a study based on ‘ Age determination form Clavicle: A radiological study in Mumbai Region’. The sample consists of 131 males and 68 females between age group of 3 - 23 years. Age was confirmed from history and the identity card.

Cases with nutritional, developmental and endocrine abnormalities which affect the skeletal growth had been ruled out from the study population. X Ray Anterio Posterior view of the medial end of the clavicle was taken. The medial clavicular epiphysis was observed for appearance and other stages of fusion. Scoring system was based on Dr.William Sangma et al and McKern and Stewart's methods.

The 5 stages were:

- Stage 1: When the epiphyseal cartilage did not begin to decrease in thickness, it was staged as Non Union.
- Stage 2: Commencement of union occurs w[h]en epiphyseal cartilage thickness found to be reduced appreciably
- Stage 3: In incomplete union, epiphysis had started to unite with its shaft
- Stage 4: Completeunion : When the epiphyseal cartilage was bony in architecture and its density indistinguishable from the epiphysis and diaphysis in its neighbourhood but an epiphyseal line called epiphyseal scar could still be distinguished Stage 5: Complete union with absence of epiphyseal scar.

The various stages of ossification was evaluated radiographically and results were compared with known standards. In both male and female, medial clavicular epiphysis appeared at 15 - 16 years. Complete fusion occurred at 23 - 24 years in males and at 21 - 22 years in females. Males showed earliest union at 21 years and females at 20 years. The results of this study are close to the results of Flecker, Galstaun, Chaurassia, Parikh and Krishan Vij.

Cameriere R[49] et al (2012) done study on 'Reliability of Schmeling's stage of ossification of medial clavicular epiphyses and its variability to assess 18 years of age in living subjects'. It was a retrospective study and a sample of chest radiographs of 274 subjects; aged between 12 to 25years was studied based on Schmeling's method. It was concluded in the study that it was very difficult to clearly identify the five stages of ossification by using conventional chest radiography.

MEDICOLEGAL IMPORTANCE OF AGE:

8. Medicolegal importance of age:

- **From birth to 1 year of life:**

  Child is called as an infant and killing of the infant is infanticide. In India, no separate law is available for infanticide, it is considered as child murder.

- 5 years of age:

  Custody of the minor, who has not completed the age of 5 years, shall ordinarily rest with the mother.

- **7 - 1 2 years of age :**

  (a) A child below 7 years of age is exempted from criminal liability, since the child is not having criminal intent (82 IPC); (b) Child above 7 years and below 12 years may or may not held guilt depending on presence of or absence of maturity (83 IPC); (c) Kidnapping or abducting child below 10 years of age is punishable (369 IPC);

- **14 years of age:**

  Child less than 14 years cannot be employed in factory.

- **15 years of age:**

  (a) Child above 15 years can be employed in factory subject to the production of fitness certificate for the particular employment;

  (b) Police cannot compel the attendance of an individual below 15 years at any place other than their residence (160 Cr.P.C)

- **16 years of age:**

  (a) Kidnapping a male child below 16 years of age (361 IPC) and maiming for employing him for begging are punishable (363 A IPC);

  (b) Consenting age for sexual intercourse by a female; but as per Criminal law Amendment bill 2013, the age for consent for sexual intercourse is 18 years.

- **17 years of age:**

  Candidate should attain 17 years of age for MBBS admission.

- **18 years of age:**

  (a) Qualifying age for marriage for the bride;

  (b) Kidnapping a female child below 18 years of age (361 IPC) and maiming her for employing for begging are punishable (363 A IPC);

  (c) By completion of age 18 one can become ‘major’;

  (d) Below 18 years can not valid consent to suffer any harm;

  (e) Abetment of suicide of one below 18 years of age is punishable;

  (f) Above 18 years of age can exercise vote, can authorize organ removal and can make a ‘valid will*.

- **20 years of age:**

  To any individual below 20 years of age, selling, distributing, exhibiting or circulating obscene objects is punishable (293 IPC).

- **21 years of age:**

  (a) Individuals under the guardianship of court can attain majority only after completion of 21 years,

  (b) Qualifying age of marriage for bridegroom.

- **25 years of age:**

  (a) Minimum age for contesting in MLA and MP elections

  (b) Maximum age for entering in to Government service.

- **35 years of age:**

  (a) Minimum age for appointment as President, Vice-President or Governor in India;

(b) No prenatal diagnostic technique shall be employed unless the age of the pregnant women is above 35 years.

- **55-60 years of age:**

Age of retirement in State Government or some Autonomous bodies.

- **60 years of age:**

Age of retirement for Central Government employees.

- **70 years of age:**

Age of retirement for medical teacher in Private Institution.

MATERIALS AND METHODS:

9.MATERIALS AND METHODS:

After obtaining written consent for their radiological examination, the persons selected for study were grouped as per their stated age viz, 16-17- yrs, 17-18-yrs & 18-19 yrs. The persons belonging to the age group selected for either gender are included in the study irrespective of their socio- economic, religious and educational status.

Age as stated by them is further confirmed by birth certificate or entry in their school record.

Each person is X-rayed for shoulder joint & subsequently the skiagrams are studied in detail in reference to various ossification centres, their appearance, process of fusion and post fusion scarring

Subject selection:

People should be living in Chennai regions for greater than 5 yrs.

Inclusion Criteria:

Persons aged 16-19 yrs and should have accurate record of their Date of Birth.

Exclusion Criteria:

They should be free from any physical debility.

As per the observations and analysis of previous studies based on radiological assessment of degree of fusion of epiphysis of shoulder joint in this study, X ray antero- Posterior view was taken to study the fusion of shoulder joint.

Ossification process at the shoulder joint was divided in to the following grades:

a. Centre not appeared.
b. Centre appeared but incomplete.
c. Union started but incomplete.
d. Complete Union.

9.1 Criteria for fusion:

(a) There should be no gap or defect in the epiphyseodiaphyseal region of the bone.

(b) There should be no discontinuity in the outline of the bone.

(c) Presence of epiphyseal scar in considered as fused.

9.2 Criteria for non fusion:

There should be a clear gap or defect which resembles a fracture line between epiphysis and diaphysis of the bone. Even a small defect in any of the two sides of the bone is considered as 'not fused'. Results were tabulated.

ANALYSIS OF RESULTS

10. ANALYSIS OF RESULTS

60 Radiographs in the age group of 16-19 yrs were analyzed, of which were male and were female

Table 1: Sample distribution among male and female

Age Group	Male	Female	Total
16-17	11	10	21
17-18	13	10	23
18-19	06	10	16

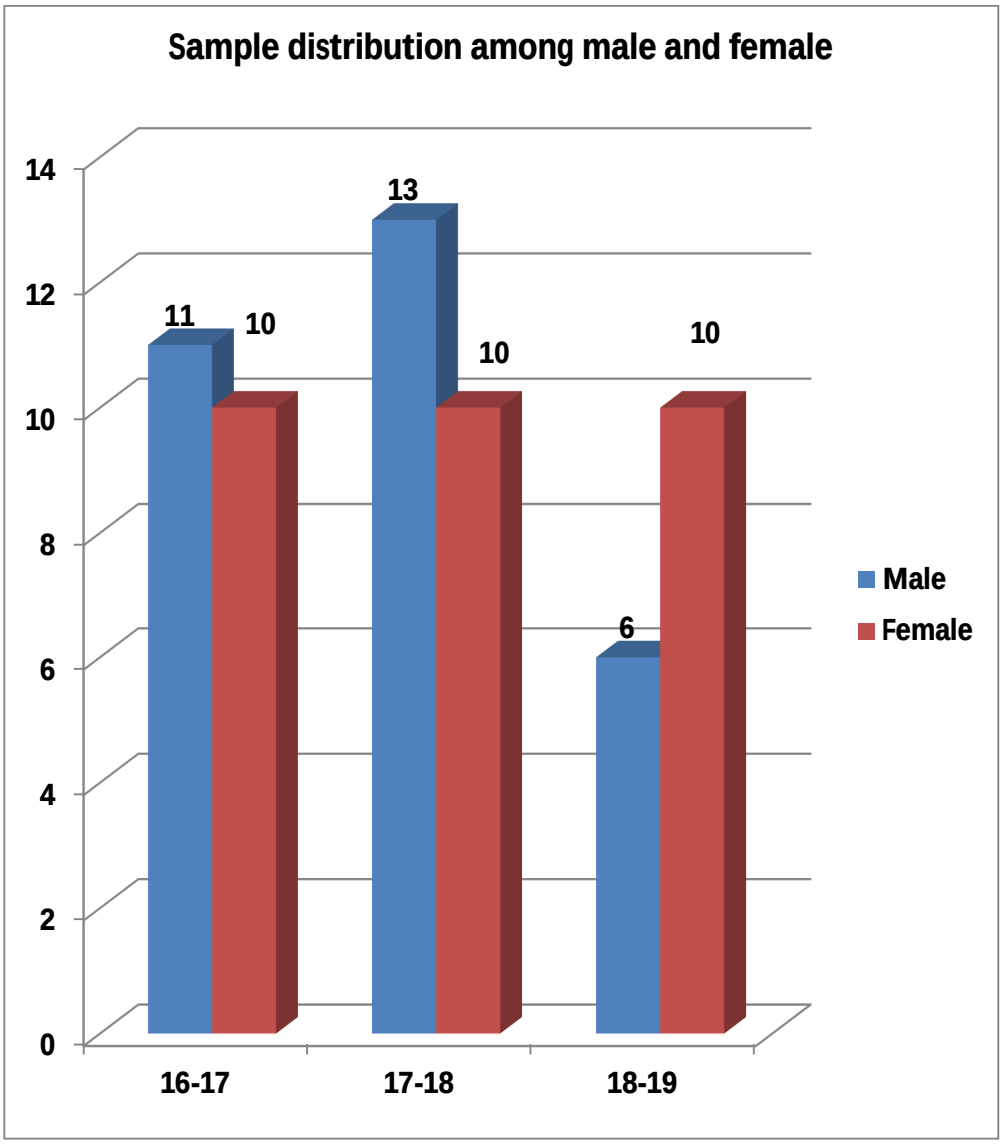

Sample distribution among male and female
14
12
10
8
6
4
2
0
11
10
13
10
6
10
16-17
17-18
18-19
Male
Female

Table 2. Stage of fusion of epiphysis of Shoulder joint

Stage	I	II	III	IV
16-17	06	06	06	03
17-18	04	05	06	08
18-19	01	03	05	07

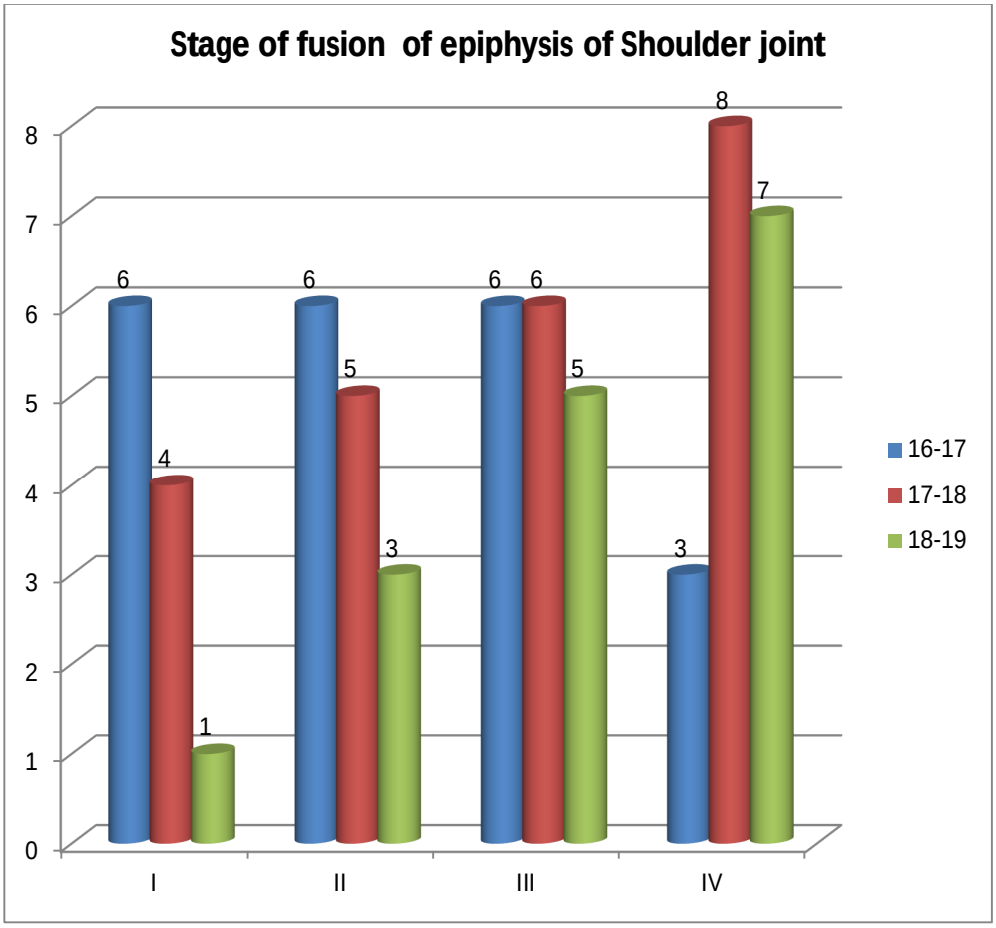


Table 3: Stage of fusion of the epiphysis of shoulder joint among females.

Stage	I	II	III	IV
16-17	02	02	02	03
17-18	01	02	03	04
18-19	00	02	03	05

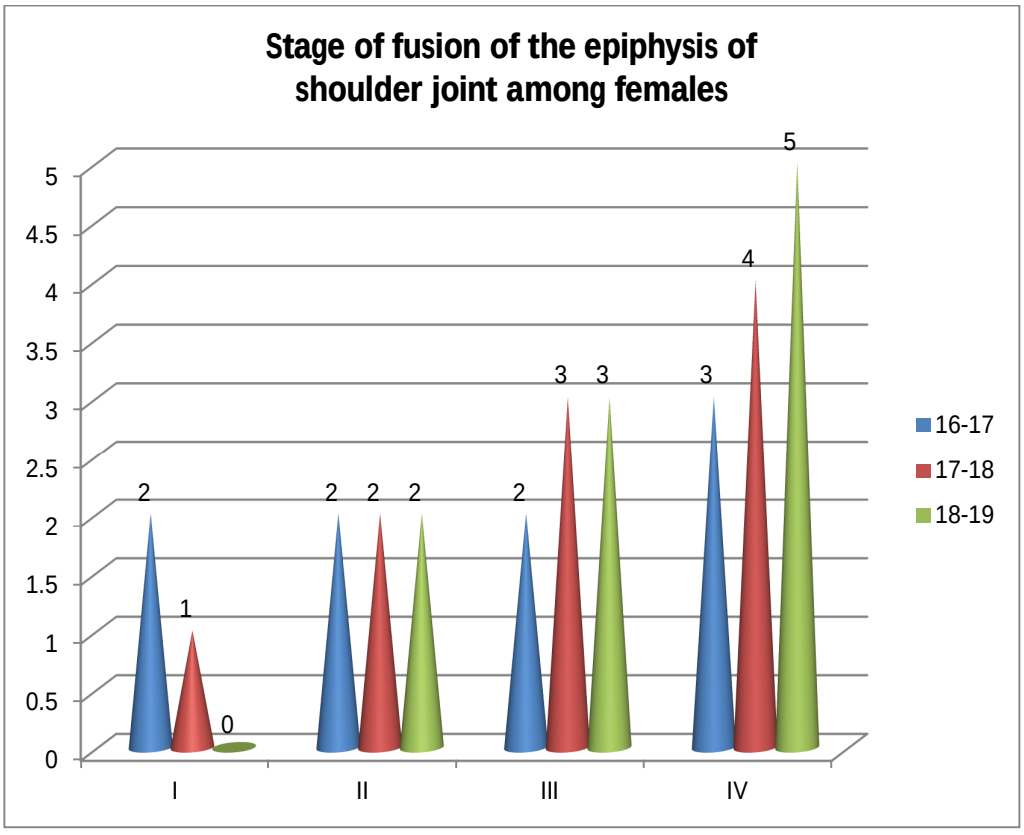


Table 4: Stage of fusion of the epiphysis of Shoulder joint among males.

Stage	I	II	III	IV
16-17	04	04	03	00
17-18	03	03	03	04
18-19	01	02	02	02

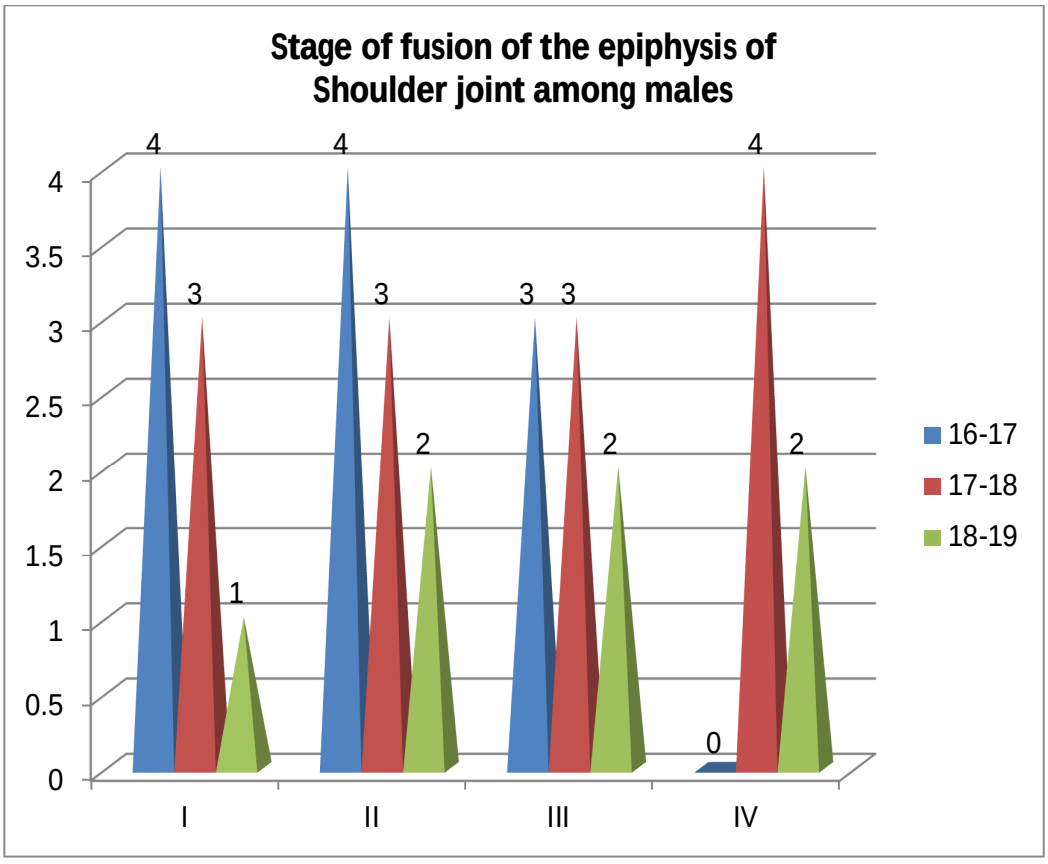
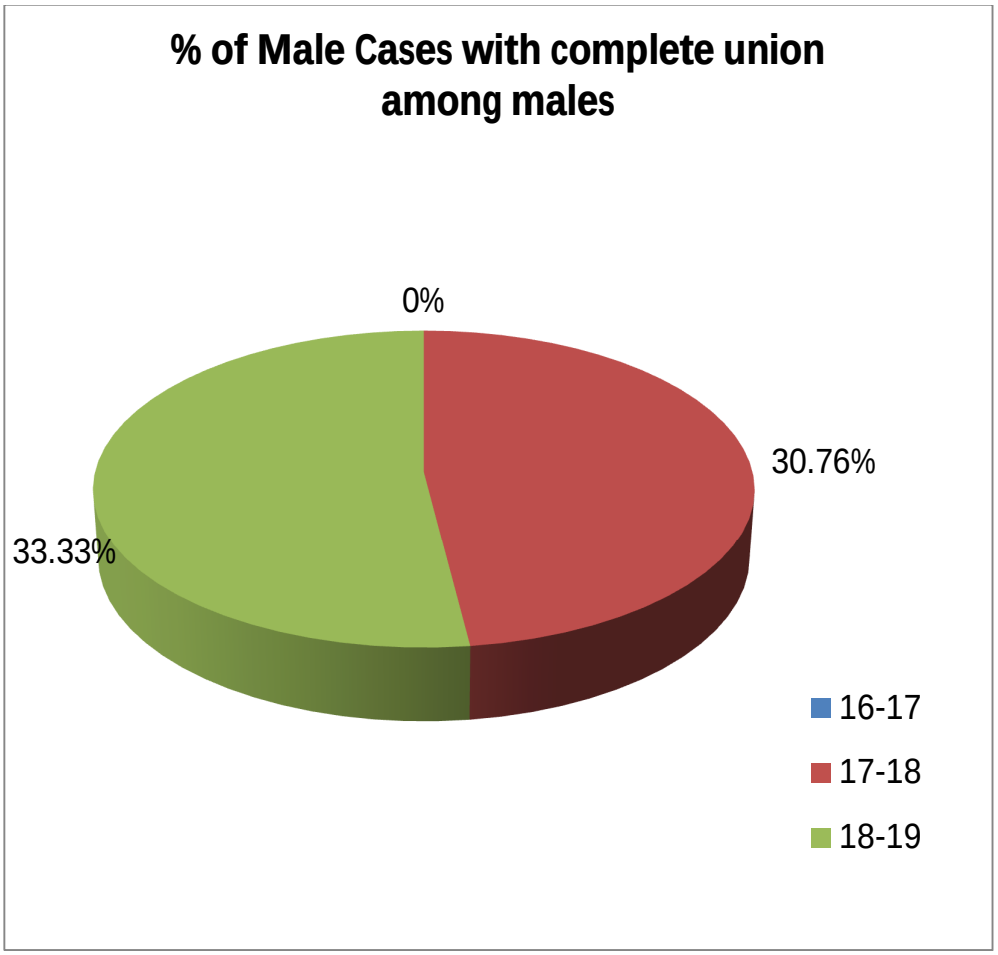
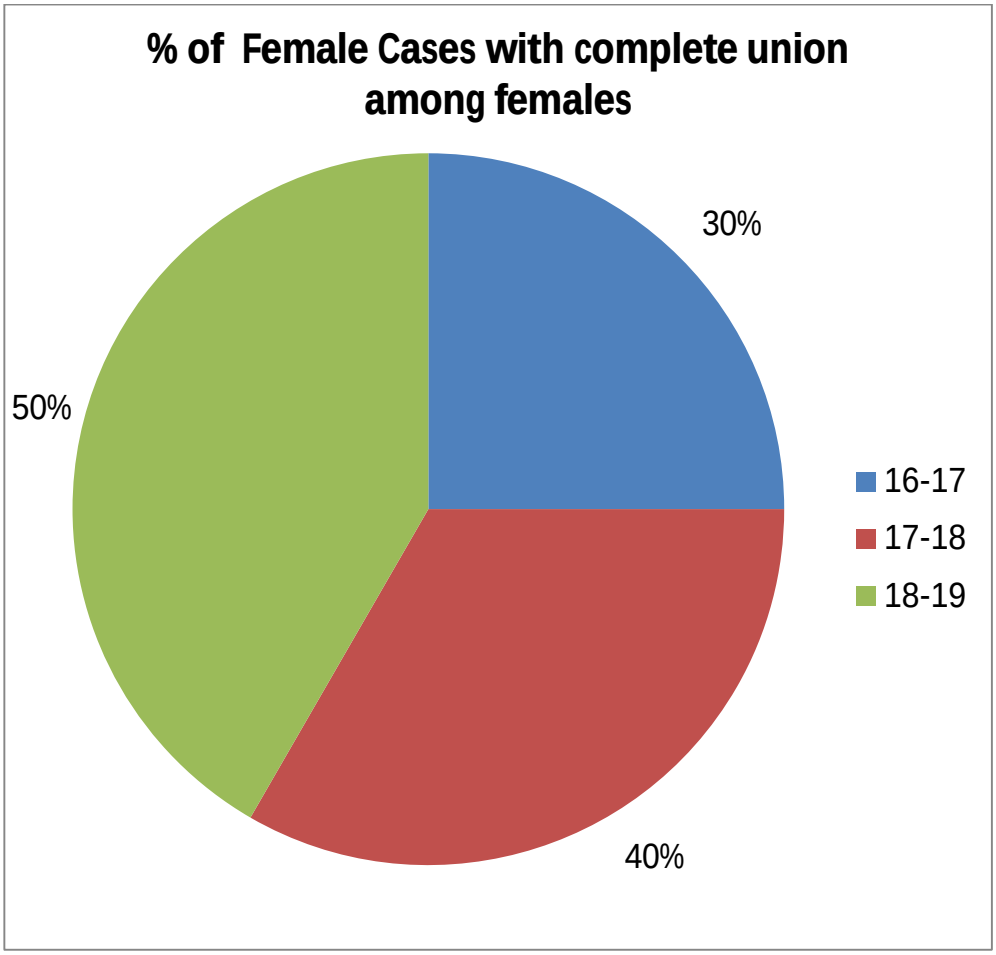


Table 5: Age of incidence of complete union

Age Group (years)	No. of Cases	% of Male Cases with complete union among males	% of Female Cases with complete union among females
16-17	21	0%	30%
17-18	23	30.76%	40%
18-19	16	33.33%	50%

Age of incidence of complete union




% of Female Cases with complete union among females
30%
50%
40%
16-17
17-18
18-19

DISCUSSION

11. DISCUSSION

11.1 OSSIFICATION OF SHOULDER JOINT

The centre of the humerus appears during the first year of life. For the greater tubercle during the 2nd year and for lesser tubercle by 5 years.

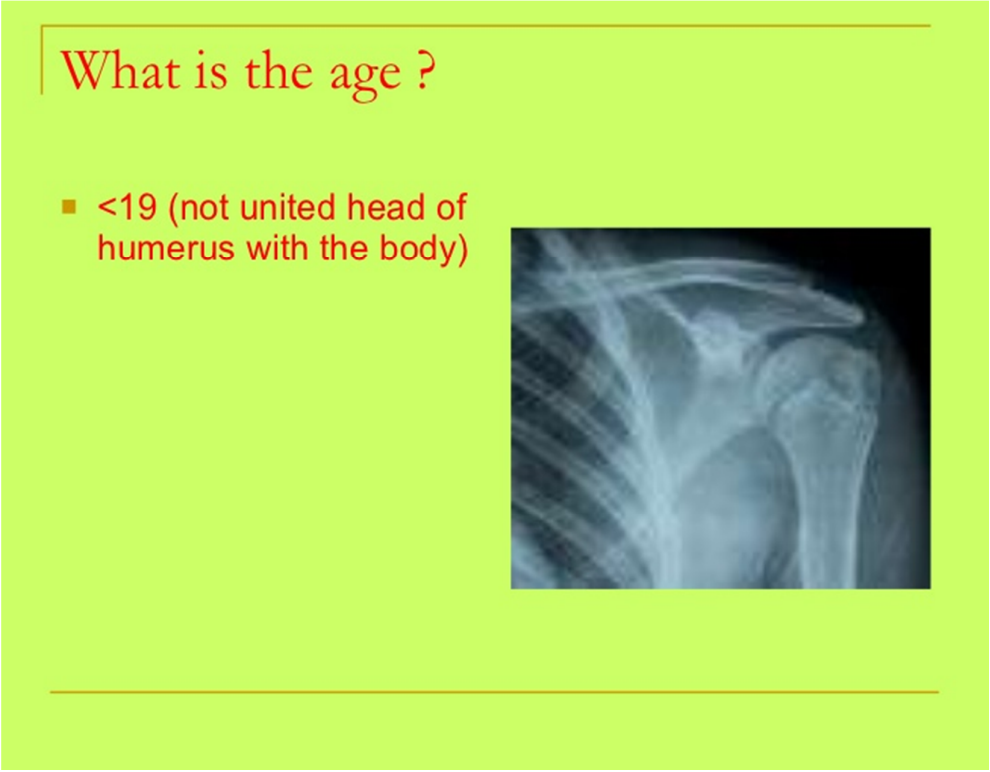


Fig. 6 : RADIOGRAPH OF A SHOULDER JOINT <19 YRS

The three centres unite to form a compound epiphysis by 6 years, which unites with the shaft at 13 – 17 years in females and about 16 – 20 years in females. The corocoid and acromion both ossify from separate centres, which are readily visible on radiographs.

Fig. 7 : RADIOGRAPH OF A SHOULDER JOINT >19 YRS

The centre for the tip of corocoid process appears about at 13 years and unites by 20 years. The centre at the tip of acromion appears around 15 years and unites between 18 and 20 years.

It is possible to determine the approximate age of an individual by radiological examination of bones till the ossification completes. In the present study, the skeletal maturity at the shoulder joint known chronological age of the Tamilnadu population was analyzed.

21 radiographs in the age group of 16 – 17 years were analyzed of which 11 were male and 10 were female.

Secondary ossification centre showed no union in 4 cases in the age group of 16 – 17 years.i.e 4 cases (36.34%)were in stage I.

- 4 cases (36.34%) were in stage II i.e (Showed beginning of union)
- 3 cases (27.27%)were in stage III i. e (Showed recent union)

None of them (0%) showed complete union of the secondary ossification centre in the age group of 16 – 17 years among males.

Secondary ossification centre showed no union in 2 cases (20%) in the age group of 16 – 17 years among females.i.e 2 cases were in stage I.

- 2 cases (20%) were in stage II i.e (showed beginning of union)
- 3 cases (30 %) were in stage III i.e (showed recent union)
- 4 cases (40 %) were in stage IV i.e (showed complete union) only documented study done previously in jaipur region by Dr. Saini OP et al was available for standard comparison in Chennai region, the observation of present study correlates with observations of present study.

23 radiographs in the age group of 17 – 18 years were analyzed of which 13 were male and 10 were female.

Secondary ossification centre showed no union in 3 cases (23.07%) in the age group of 17 – 18 years among males. I.e 3 cases were in stage I

- 3 cases (23.07%) were in stage II i.e (showed beginning of union)
- 3 cases (23.07%) were in stage III i.e (showed recent union)
- 4 cases (30.76%) were in stage IV i.e (showed complete union)

Secondary ossification centre showed no union in one case (10%) in the age group of 17 – 18 years among females.

- 2 cases (20%) were in stage II i.e (showed beginning of union)
- 3 cases (30%) were in stage III i.e (showed recent union)
- 4 cases (40%) were in stage Iv i.e. (showed complete union)

16 radiographs in the age group of 18 – 19 years were analyzed of which 6 were male mad 10 were female.

Secondary ossification centre showed no union in one case(16.66%) in the age group of 18 – 19 years among males.

- 1 case(16.66%) were in stage II i.e. (showed beginning of union)
- 2 cases (33.33%) were in stage III i.e. (showed recent union)
- 2 cases (33.33%) were in stage IV i.e. (showed complete union)

Secondary centre showed no union in 0% of cases (stage I) in the age group of

- 18 – 19 years among females.
- 2 cases were in stage II i.e. (showed beginning of union)
- 3 cases were in stage III i.e. (showed recent union)
- 5 cases were in stage IV i.e. (showed complete union)

In the present study, majority of cases showed complete union of epiphysis at shoulder is seen by 17-18 years in males and 16-17 years in females.

The present study signifies that epiphyseal centers in females mature 1-2 years earlier than in males. This observation correlates with the previous studies.

Fig. 8 : RADIOGRAPH OF A SHOULDER JOINT-9 YRS

CONCLUSION

12. CONCLUSION

Radiological examination of the ossification activates of the bones helps to determine the Approximate age of an individual. Age can be determined only in terms of range of two to five years based on the appearance and fusion of the ossification centers. On examination 60 radiographs of the shoulder joint the age of complete fusion of epiphysis of the shoulder joint is 17-18 years for males and 16-17 years for females. Earliest union occurred at the age of 15 years in females and 17 years in males.

In the present study, the age group of complete fusion is higher than the previous studies. The reason for this difference may be the geographical, nutritional and endocrine factors which influence the skeletal maturity. Age estimation from teeth, skull and pelvis has been done conventionally but each method has its own limitation and they are influenced by endocrine, racial, dietary and sex factors.

These methods can be used to categorize age into broad age groups. Estimation of age based on fusion of epiphysis of shoulder joint plays a vital role in forensic age diagnosis of living adolescents and young adults. Sex difference is noted in the age of fusion of epiphysis of shoulder joint by 1-2 years. Females show 2 years earlier onset of fusion than males.

12.1 AGES OF MEDICOLEGAL IMPORTANCE :

Almost every age is important from a medicolegal perspective. The example in this paper give only a glimpse of the full range of ages which a practicing medicolegist may be asked to give opinion.

These will vary from country to country mad even within various states of the country. It would be helpful for a particular medicolegist of a particular state or country to compile his/her list in accordance with his/her own laws.

An illustration of some of the ages with medicolegal importance are given below:

For the approximate estimation of age, the following paragraphs should be correlated.

FIRST FIFTEEN DAYS :

The changes in the umbilical cord and the skin.

FIRST SIX MONTHS :

Weight and the height, anterior fontanelle closure and fusion of the two halves of mandible. The ossification centres in the capitate appears during second month after birth.

SIX MONTHS TO TWO YEARS :

The eruption and calcification of temporary teeth is the best guide and the appearance of the ossific centres and their size in heads of carpus, humerus,femur and the tarsus.

TWO TO SIX YEARS :

Ossification of the tarsus and carpus and appearance of centres in epiphysis of long bones. The number of carpal bones seen on radiographs indicate the approximate age in years in the age group of 2 – 6 years.

SIX TO THIRTEEN YEARS :

Eruption and calcification of the permanent teeth is very helpful. Centres that have already appeared may prone to alterations and additional centres appear.

THIRTEEN AND SIXTEEN YEARS :

The changes of puberty and ossification of bones, especially I the region of the elbow joint.

SIXTEEN TO 25 YEARS :

The epiphyses of most of the long bones unite with the shafts . The union of the epiphysis of ends of ribs, clavicles and iliac crest during this period. Between 20 – 30 years, incisors, tips of canines

and cusps of premolars show incisors, tips of canines and cusps of premolars show slight to moderate wear. In the early twenties, the sternal rib shows a scalloped rim around a deepening V-shaped pit in both sexes.

25 TO 35 YEARS :

The saggital, coronal and lambdoid sutures of the skull start to close. The changes in the symphysis pubis are very important.

35 TO 50 Years :

There is further progress in the changes in the symphysis of pubis.. Between 30 to 40 years, tooth cusp wear may be moderate to severe. The medullary cavity of the humerus may have increased upward to the level of the lower end of the tuberosity.Wrinkles about the eyes, eyebrows and in front of the ears appear about 35 to 40 years. About forty years, the Xiphoid process unites with the sternum. Between 40 – 50 years, vault sutures are all united both ectocranially and endocranially. The cortex of the long bones becomes less dense and thinner. The medullary cavity may extend upward to almost surgical neck in the humerus. Large sized atrophic

areas in the iliac fossa and scapula appear. The inner borders of the ischial tuberosities and the lumbar vertebral margins show lipping by 40 years, which becomes well marked by 45 years. By the end of the fifth decade, bony projections from the superior and inferior margins of the rib is appears well in males, and the pit deepens and widens. In the females, the pit is relatively shallow and the bone itself is thinner. Ossification of the laryngeal and costal cartilages with that of hyoid bone usually begin.

Bony articular surfaces show changes earlier. They include joint space reduction, lipping and the presence of punched out areas of osteoporosis on radiological examination. Ivory- like to granular appearance and feel of the skull bones appear.

50 TO 60 YEARS :

The external tables of the vault become slightly thinner. The molar crowns of the teeth are usually worn flat to a single plane. The crown of all the molar cusps appears in a flat plane, an age of fifty plus is considered.

AFTER SIXTY YEARS :

Further closure of sutures of skull occurs. In the fifties and sixties, small osteophytic spurs or spikes occur in the linea and tuberosities of muscle attachment which usually becomes well advanced in the seventies. osteoporosis is more marked and changes in the joint becomes well marked in character. The joint between the body of the sternum and the manubrium may fuse and the calcification of the tracheal and laryngeal cartilages become more visible. The pathological skeletal changes are the predominant changes of this period. The hair may become silvery white. The lower and upper jaws becomes completely edentulous usually around the age of 70 years.

MASTER CHART

S. NO.	NAME	SEX	ALLEGED AGE	DATE OF BIRTH	I	II	III	IV
1	Naveen	Male	18	2/10/1997	+	-	-	-
2.	Ajith	Male	18	15/10/1997	+	-	-	-
3.	Durai Raj	Male	18	24/11/1997	-	+	-	-
4.	Sathish Aaaksh	Male	17	18/11/1988	+	-	-	-
5.	Ananth Vikranth	Male	17	9/10/1998	-	+	-	-
6.	Durai Babu	Male	17	15/09/1997	-	-	+	-
7.	Hari haran	Male	18	24/06/1997	-	-	+	-
8.	Mohan Raj	Male	18	16/12/1997	-	-	+	-
9.	Muthu Kumar	Male	18	15/03/1998	-	-	-	+
10.	Manoj	Male	18	11/03/1997	-	-	-	+
11.	D. Vinoth Kuumar	Male	17	11/11/1997	-	-	-	+
12.	E. Suresh Kumar	Male	17	04/11/1997	-	-	-	+
13.	Anju	Female	17	24/03/1997	-	-	-	+
14.	Pavithra	Female	18	26/06/1997	-	-	-	+
15.	Farzana	Female	18	04/09/1997	-	-	-	+
16.	Shruti	Female	18	02/02/1997	-	-	-	+
17.	Saranya	Female	18	5/04/1997	-	-	+	-
18.	Sathya Banu	Female	17	4/01/1998	-	-	+	-
19.	Sujatha	Femal	17	12/04/1998	-	-	-	+
20.	Ramya	Female	17	5/06/1998	-	+	-	-
21.	Pratheeba	Female	17	6/03/1998	-	-	-	+
22.	Viswapriya	Female	17	3/06/1998	-	-	-	+
23.	Gokula Kannan	Male	17	25/10/1998	+	-	-	-

S. NO.	NAME	SEX	ALLEGED AGE	DATE OF BIRTH	I	II	III	IV
24.	Kishore Kumar	Male	17	26/11/1998	+	-	-	-
25.	Gokul	Male	17	02/12/1998	+	-	-	-
26.	Sri hari Ram	Male	17	15/12/1998	+	-	-	-
27.	M.Venkatesh	Male	17	12/10/1998	+	-	-	-
28.	B. Ramesh	Male	16	31/04/1999	-	+	-	-
29.	V. Boopathy	Male	17	11/12/1998	-	+	-	-
30.	V.Narayanan	Male	17	25/12/1998	-	+	-	-
31.	E. Haridoss	Male	16	31/01/1998	+	-	-	-
32.	V.Ganesan	Male	16	01/12/1999	+	-	-	-
33.	M. Prabhu	Male	16	5/03/1999	+	-	-	-
34.	T. Mathan Kumar	Male	16	01/05/1999	-	+	-	-
35.	T.Naushath Begum	Female	17	12/10/1998	-	+	-	-
36.	S.Thendral	Female	17	02/11/1998	-	+	-	-
37.	M.Vijayarani	Female	17	15/11/1998	-	-	+	-
38.	T. Anitha	Female	16	15/04/1999	-	-	+	-
39.	B. Kokila	Female	16	05/04/1999	-	-	-	+
40.	Karthikaa	Female	16	31/03/1999	-	-	-	+
41.	R.Dharini	Female	16	24/06/1999	-	-	-	+
42.	Keerthana	Female	16	04/06/1999	_	_	_	+
43.	P. Ganesan	Male	16	01/02/1999	+	-	-	-
44	M.Saravanan	Male	19	03/09/1996	-	-	-	+
45.	A.Gugan	Male	18	19/03/1997	-	-	-	+
46.	MLD. Prakash	Male	18	20/05/1997	-	-	-	+
47.	D. Gopinath	Male	19	01/09/1996	-	-	-	+
48.	Nanda Kumar	Male	19	19/05/1996	-	-	+	-

S. NO.	NAME	SEX	ALLEGED AGE	DATE OF BIRTH	I	II	III	IV
49.	Sree hari	Male	19	20/06/1996	-	-	+	-
50.	R. Harini	Female	19	25/10/1996	-	-	+	-
51.	Malarvizhi	Female	18	24/02/1997	-	+	-	-
52.	V. Saraswathi	Female	18	05/05/1997	-	+	-	-
53.	E. Sangeetha	Female	18	14/05/1997	-	-	-	+
54.	Vijayalakshmi	Female	18	04/06/1997	-	-	+	-
55.	S. Annapoorani	Female	18	11/07/1997	-	-	+	-
56.	A. Agnes lalitha	Female	18	16/09/1996	-	-	+	-
57.	M.Deepalakshmi	Female	19	15/11/1997	-	-	-	+
58.	Ranjana Shah	Female	18	30/06/1997	-	-	-	+
59.	Mamtha	Female	18	20/04/1997	-	-	-	+
60.	M.Priyanka	Female	18	15/03/1997	-	-	+	-

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